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Final Report

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Evaluation of Backrubber Insecticides for Black Fly Control

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EVALUATION OF BACKRUBBER INSECTICIDES FOR BLACK FLY CONTROL
PROJECT #R-89-01-0423
FINAL REPORT

Prepared for the
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a) EXECUTIVE SUMMARY

Abstract

During the summers of 1989/90 four backrubber insecticides, Ectiban[R], Bovitect[R], Atroban Delice[R], and Liquiduster were evaluated for their effectiveness in controlling black flies, especially *Simulium luggeri* attacking beef cattle. Evaluations were done using a backrubber in a forced use situation. Ectiban[R], used in solution with diesel oil, reduced black fly numbers around the cattle by 83%. Bovitect[R] ready to use solution reduced the number of black flies around cattle by 56%. Atroban Delice[R] ready to use solution effectively reduced black fly numbers by 100%. Liquiduster ready to use solution in a self-contained backrubber reduced black fly numbers around cattle by 72%.

Summary

Black flies; particularly *Simulium luggeri* are a major pest of livestock in N.E. Saskatchewan. Cattle under stress from black fly attack directly affect the producers ability to maximize productivity in a number of ways. Producers potentially have to deal with unrealized weight gains, reduced milk yields, delayed conceptions, an assortment of cattle fatalities and increases in stress related injuries and diseases.

At present the Saskatchewan River System is treated annually to control black flies. In spite of the effectiveness of treatments, black fly attacks are not entirely eliminated and in years of unusually high black fly numbers harassment of livestock occurs. Thus producers may at times require additional or alternative forms of black fly control. Backrubbers as a means of applying pesticides to cattle for black fly control have been demonstrated to be effective in both Alberta and Saskatchewan. However only one pesticide, malathion is registered for use in backrubbers to control black flies. A two year study was initiated at a farm near Kinistino (an area with persistant black fly problems) in order to provide the data necessary for the registation of additional pesticides for on farm black fly control.

In the summer of 1989 the pesticides Ectiban[R] and Bovitect[R] were tested in backrubbers for their effectiveness in controlling black flies. In 1990 Atroban Delice[R] and Liquiduster were tested. In both years of the study weather parameters such as wind direction, wind speed, temperature, relative humidity, per cent cloud cover and cloud type were measured to determine if any of these factors influenced the effectiveness of treatments. In addition to this cattle behavior namely ear twitches and tail tosses were also observed and recorded.

Analysis of the data (which involved counting and comparing the number of black flies caught by sweep net between a group of cattle treated by the individual pesticide and a group of cattle not treated by the pesticide) showed that all but Bovitect[R] were effective in controlling blackflies attacking cattle. An analysis of weather data indicated that these factors did not influence the number of flies atacking either group of cattle. A comparison between the number of ear twitches and tail tosses counted between the treated versus untreated cattle showed that the treated cattle potentially under went less stress than untreated cattle.

From the results of this 2 year study we recommend that the data for Ectiban [R], Atroban Delice[R] and Liquiduster be submitted to Pesticides Directorate, Agriculture Canada for registration under the Minor Use Program.

b) TECHNICAL REPORT

Abstract

During the summers of 1989/90 four backrubber insecticides, Ectiban®, Bovitect®, Atroban Delice®, and Liquiduster were evaluated for their effectiveness in controlling black flies, especially *Simulium luggeri* attacking beef cattle. Evaluations were done using a backrubber in a forced use situation. In 1989 Ectiban® (Permethrin 240 g/L), used in solution with diesel oil, reduced black fly numbers around the cattle by 83% ($P<0.05$). Bovitect® (Permethrin 50 g/L) ready to use solution reduced the number of black flies around cattle by 56% although it was not statistically significant ($P>0.05$). In 1990 Atroban Delice® (Permethrin 1%) ready to use solution effectively reduced black fly numbers by 100% ($P<0.001$). Liquiduster (Permethrin 1%) ready to use backrubber solution reduced black fly numbers around cattle by 72% ($P<0.001$).

In all evaluations significantly ($P<0.001$) fewer ear twitches and tail swishes were recorded for animals treated with insecticide verses animals that were not treated. Meterological factors did not have any influence on the numbers of black flies collected around treated or untreated groups. Pasture location also did not influence numbers of black flies collected.

Background and Objectives

Black flies, primarily Simulium luggeri, are a major pest of livestock in N.E. Saskatchewan. During years of high black fly activity, losses to livestock producers may include some or all of the following: unrealized weight gains, reduced milk yields, delayed conceptions, cattle fatalities and increases in stress related injuries and diseases (Fredeen 1985). At present a larviciding control program is carried out annually on the Saskatchewan River system. Despite the effectiveness of these treatments black fly populations are not always entirely eliminated and in years of unusually high black fly numbers harassment of livestock continues. Thus producers may at times require alternative or additional forms of black fly control in order to maximize livestock production.

Backrubbers as a means of applying insecticides to cattle for black fly control offer a number of advantages to the producer over more conventional on-farm control methods such as manual sprays or smudges. They are more convenient and less labour intensive. There is minimal pesticide wastage and limited exposure of pesticides to humans and, when used under forced use conditions, treatment of the entire herd is ensured. This method of on-farm control for black flies that attack cattle has previously been demonstrated in Saskatchewan (Mulligan 1987) and Alberta (Khan 1986). However, only malathion is registered for use in backrubbers to control black flies.

The objective of this study was to determine, during two consecutive black fly seasons, the effectiveness of unregistered insecticides, applied by backrubber, in protecting pastured beef cattle from black fly attack. Specific objectives were to:

1) document and compare the numbers and species of black flies in the vicinity of protected verses unprotected cattle; and,

2) accumulate efficacy data for use in a submission to register the insecticides for black fly

control.

Experimental Methods

The study was conducted on Mr. Elmer Holmquist's farm near Kinistino Saskatchewan (Fig. 1).

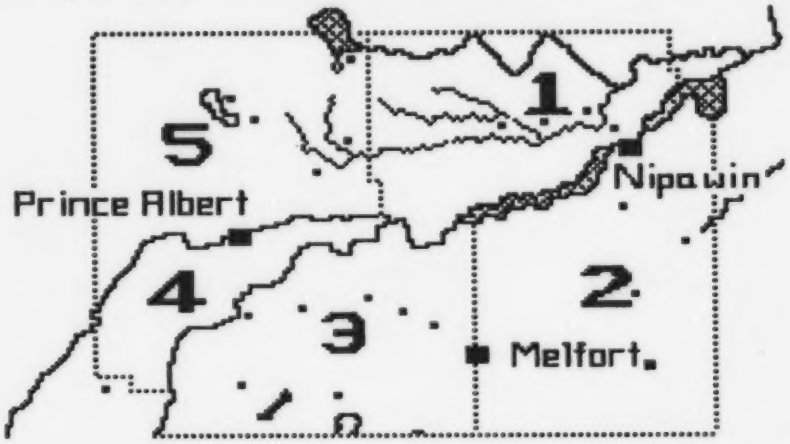

Fig. 1. Map of the Saskatchewan Black Fly Zone showing the location of the Holmquist farm.

Mr. Holmquist provided us with two equal sized herds of cattle (40 head) placed in similar-sized pastures approximately 0.5 kilometres apart. The distance between the pastures eliminated the possibility of control or treated group affecting black fly numbers around the other group. The pasture used by the treated group was gently rolling, surrounded by bush on all sides (Fig. 2a). The backrubber was located in area T1 in an alleyway where cattle had to pass under it to gain access to water. The control pasture (Fig. 2b) was about twice as large as the treated group pasture however it was divided in half using an electric fence. The animals were rotated between the two halves. The control group pasture contained a large hill which opened to pasture on the east side (CA3, CA6, CA7 and CB5) and rolled down to a stream bed (CB1 CB2) where the water hole was located. It was as well surrounded by bush on all sides.

The project commenced on May 1, 1989 and continued until August 31, 1989. In 1990 the project ran from May 15 to September 15. A backrubber (Fig. 3) which had been placed at the only access to the treated group of cattle's water supply was used to apply Ectiban®, Bovitect®, and Atroban Delice®. The Liquiduster product is a self-contained backrubber. Cattle in the control group were not treated with any of the insecticides.

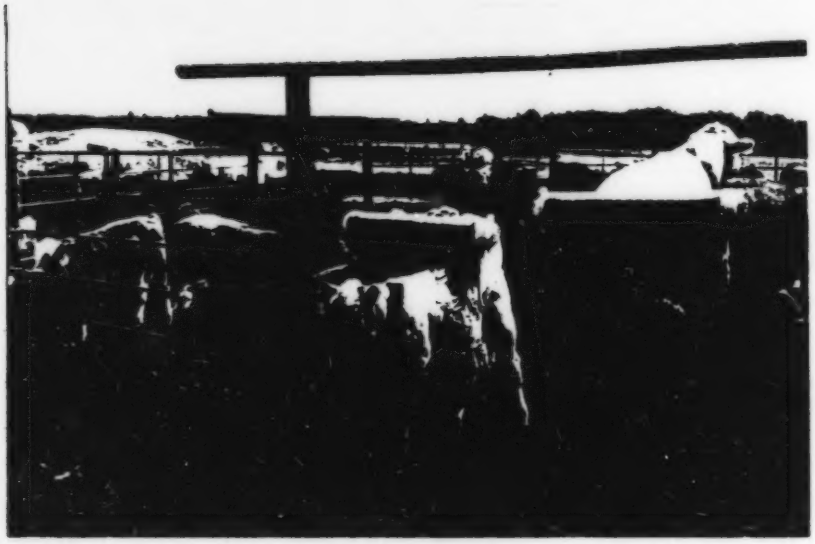

Fig. 3. Pest Doom® backrubber in a setup similar to that used to evaluate Ectiban®, Bovitect® and Atroban Delice®.

In the first trial Ectiban® (Permethrin 240 g/L), mixed with diesel fuel at a ratio of 200ml Ectiban® to 10 L of diesel was evaluated from May 29 to July 16, 1989. Bovitect® (Permethrin 50 g/L) ready to use solution was tested from July 24 to August 23, 1989. Atroban Delice® (Permethrin 1%) ready to use solution was evaluated from June 14 to July 24, 1990. The Liquiduster (Permethrin 1%) ready to use solution in a self-contained backrubber was tested from August 8 to September 14, 1990. In each year a one week waiting period was implemented between change of test insecticide and beginning of data collection so that the effects of one chemical on the results of the other would be eliminated.

During each evaluation collections of black flies, consisting of 6 sets of 50 sweeps, were taken around both herds 3 times daily (morning, midday and evening), 5 days a week for the duration of the testing period. Samples were preserved in 80% ethanol and the number of black flies in each sample counted. Specimens from representative samples were identified to species.

Selected cattle behaviour parameters were observed and recorded just after sweep net collections were taken. Individual parameters observed and recorded included leg kicks, head swings, tail swishes, ear twitches and skin quivers. Herd activities such as grazing, resting, bunching and pasture location were also recorded. At least one series of observations per herd was

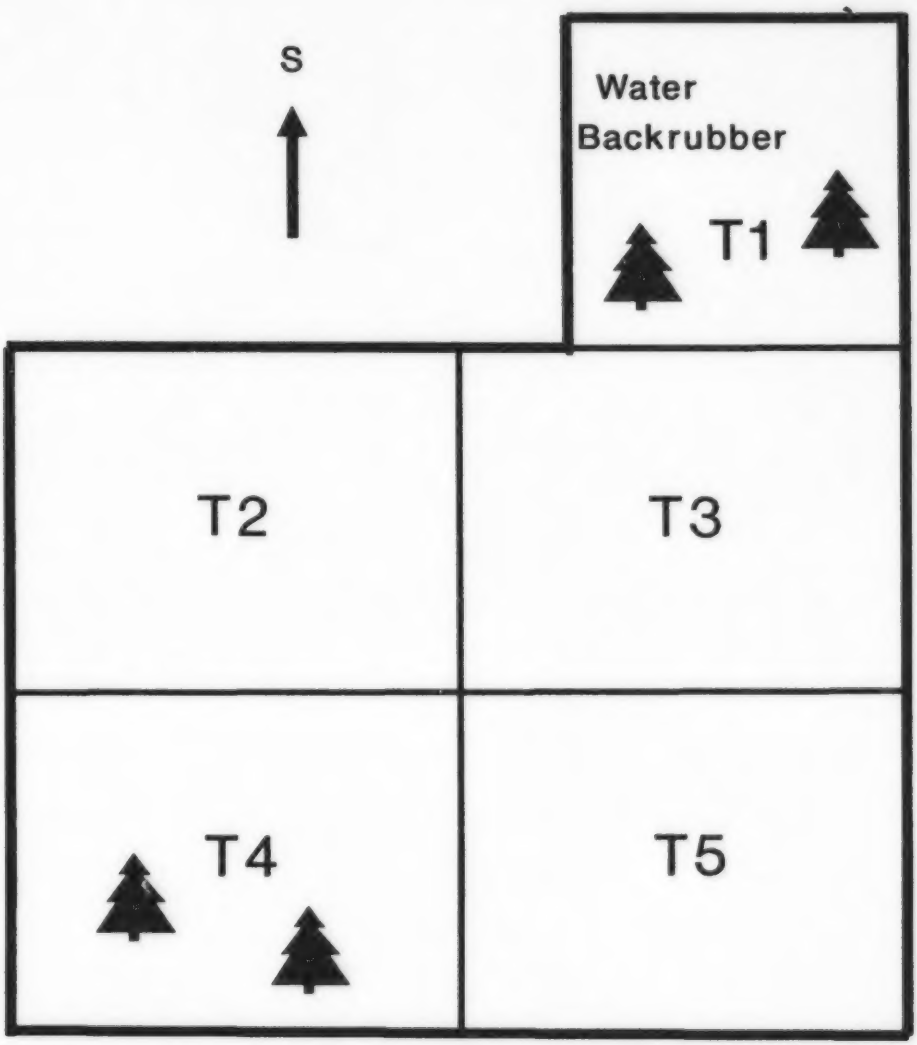

Fig. 2a. Map of pasture used by treated beef cattle during the insecticide evaluations.

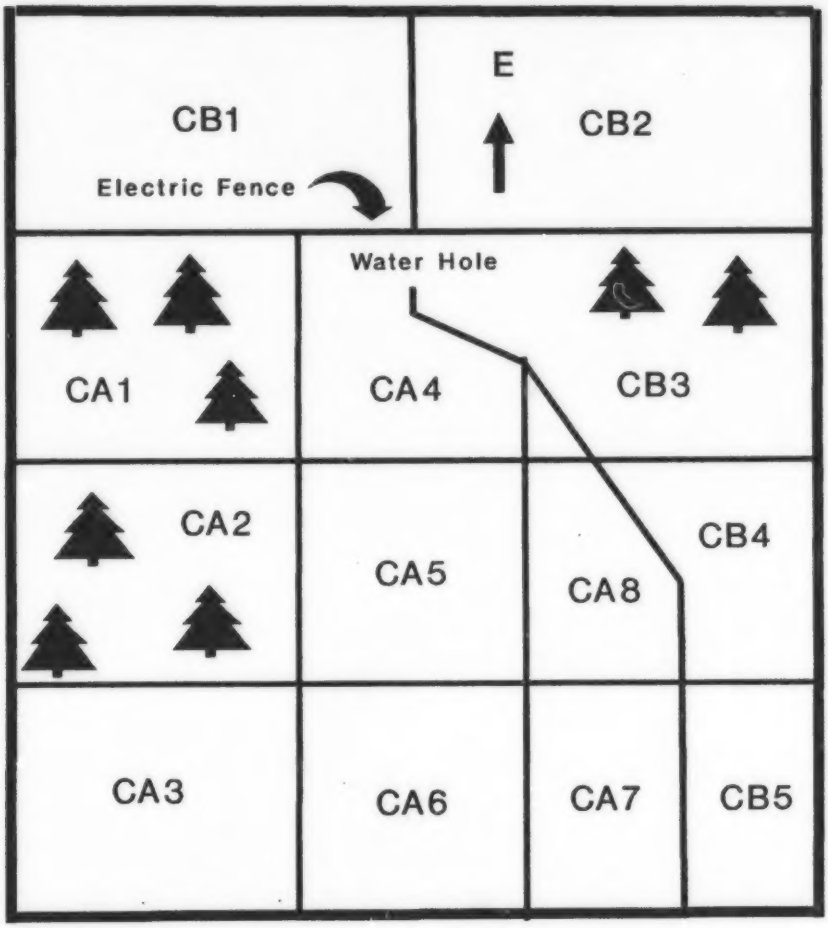

Fig. 2b. Map of pasture used by untreated (control) beef cattle during the insecticide evaluations. An electric fence was erected to separate sections CA and CB.

made daily.

Weather parameters including temperature, wind speed, wind direction, relative humidity, per cent cloud cover, cloud type and, in 1990, barometric pressure were recorded each time samples were taken. In 1990 a CO_2-baited silhouette trap was set up and sampled weekly to monitor black fly populations to provide additional data.

Statistical analyses were done using the SAS statistical software (SAS Institute 1985). Analyses were done to determine if significance occurred between the numbers of black flies collected around treated verses untreated cattle and in the behaviour of treated verses untreated cattle. Statistical analyses were also used to determine if weather parameters and pasture location influenced the results. For statistical analyses, black fly numbers were transformed using the LOG10(X+1.0) transformation to normalize the data. Arithmetic means are used in the tables.

Results

Simulium luggeri, the target pest species, constituted 95% of the specimens identified in 1989 and approximately 99% of the black flies identified in 1990.

1989 Evaluations

Approximately 87,000 flies were collected from both herds during the first trial using Ectiban[R]. The number of black flies collected around treated animals averaged 156 per day and around untreated animals 900 flies per day. Analysis of variance demonstrated that significantly fewer black flies ($P<0.05$) were collected around treated cattle compared to untreated animals (Table 1).

In the 1989 trial with Bovitect[R] 56,000 flies were collected. Counts averaged 355 per day around treated animals and 808 per day around the untreated group. Although fewer black flies were collected around treated cattle compared to untreated cattle, the numbers were not significantly different ($P>0.05$) (Table 1).

Table 1. Mean numbers of black flies collected each day around cattle during each trial in 1989.

Insecticide	Treated	Untreated
Ectiban[R]	156*	900
Bovitect[R]	355ns	808

* Treated and untreated values are significantly different ($P<0.05$).
ns Treated and untreated values are not significantly different.

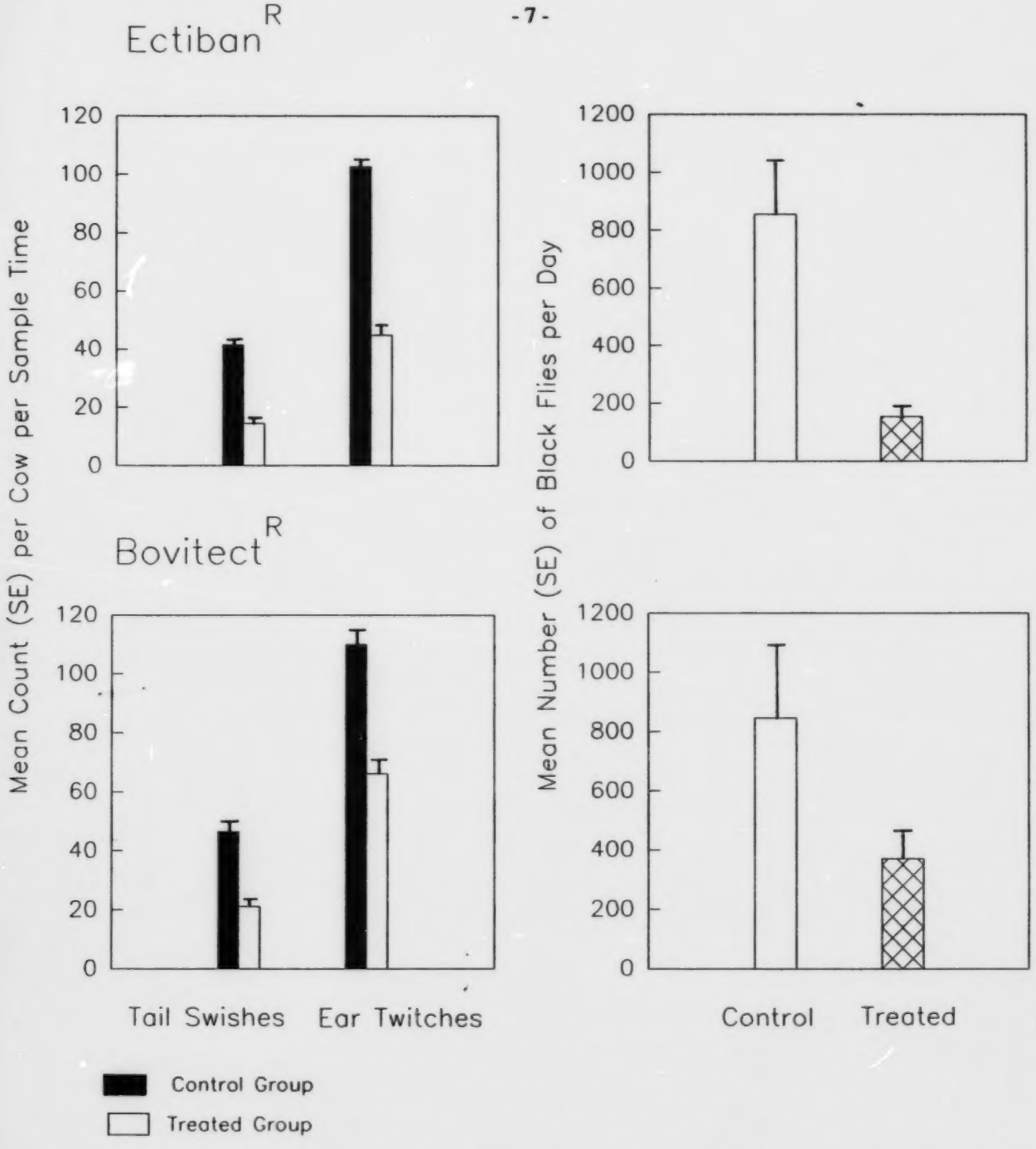

Fig. 4. Comparison between control and treated cattle of counts for tail swishes, ear twitches and black fly numbers for Ectiban[R] and Bovitect[R] insecticide trials.

The most notable changes in cattle behaviour between treated and untreated cattle occurred with the number of tail swishes and ear twitches counted. Treated animals in both trials had significantly ($P<0.001$) fewer tail swishes and ear twitches when compared to untreated cattle (Fig. 4). There were no observable differences between the two groups in the number of leg kicks, head swings and skin quivers counted. Cattle not subjected to treatment were also noted to bunch much more frequently and tended to migrate to higher parts of the pasture during bad fly days. However these observations were not significant.

Temperature, relative humidity, wind speed and cloud cover did not show any strong correlations ($r<\pm 0.35$). The effects of wind direction, cloud type, and pasture location varied (Tables 2-5).

Ectiban[R] Trial

Greatest numbers of black flies were collected around treated and untreated cattle during calm wind conditions but were not significantly different than numbers collected when North, NorthWest, South and East winds were blowing (Tables 2 and 3). Most black flies were collected around untreated cattle when Altostratus and Altocumulus clouds were present however this did not differ significantly from numbers collected when other cloud types were present, except for rain clouds (Nimbostratus). These conditions differed somewhat from black fly collections made around treated cattle where greatest numbers were collected when skies were clear but again numbers collected when most other cloud types occurred were not significantly different.

During the Ectiban[R] trial treated cattle spent most of their time in the bush near the backrubber and their water source (T1) (Table 2). Greatest numbers of black flies (a mean of approximately 500) were collected around this group when they were in open pasture (T3 and T5) but these were not significantly different than numbers collected when the cattle were in the other areas.

Table 2. Mean numbers of black flies collected around cattle treated with Ectiban® associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[a,b]216.3	7	Cirrus	[a,b]75.0	2
NorthEast	[b]76.3	8	Cumulus	[a,b]223.4	7
East	[a,b]102.4	5	Clear	[a]342.3	16
SouthEast	[a,b]56.1	11	Stratocumulus	[a,b]285.0	14
South	[a]434.40	8	Altostratus	[a,b]59.5	2
SouthWest	[a,b]75.0	2	Altostratus Altocumulus	[a,b]82.8	6
West	[b]74.2	6	Altocumulus	[a]73.0	1
NorthWest	[a,b]198.2	5	Nimbostratus	[a,b]65.7	7
Calm	[a]803.2	5	Nimbostratus Stratocumulus	[b]0	1
			Altocumulus Stratocumulus	[b]0	1

Pasture Location	Count	n=
T1**	[a]196.9	49
T2	[a]112	1
T2,T3	[a]25.5	2
T3	[a]479.5	2
T4	-	-
T5	[a]520.3	3

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2a for pasture locations.

Untreated cattle spent slightly more time on the hills in their pasture (CA4 and CA7) (Table 3), presumably to expose themselves to winds during periods of black fly activity, but numbers collected around these cattle were not significantly different than those collected when the cattle were in open pasture (CA3 and CB5), near bush (CB3) or in the stream valley (CB1 and CB2). Thus, topographic features did not influence the numbers of black flies collected for either the treated or untreated groups although treated animals tended to spend more time in a smaller area (close to the backrubber).

Table 3. Mean numbers of black flies collected around cattle not treated with Ectiban® associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[a]2102.3	7	Cirrus	[ab]326.0	2
NorthEast	[bcd]1604.8	8	Cumulus	[ab]1402.0	7
East	[c]525.4	5	Clear	[ab]1163.0	16
SouthEast	[cd]273.1	11	Stratocumulus	[ab]1659.0	14
South	[ab]1302.3	8	Altocumulus	[a]1237.0	1
SouthWest	[abc]395.0	2	Altostratus	[ab]155.0	2
West	[cd]186.8	6	Altostratus Altocumulus	[a]2365.0	6
NorthWest	[a]2271.2	5	Altocumulus Stratocumulus	[a]586.0	1
Calm	[a]2621.4	5	Nimbostratus Stratocumulus	[a]584.0	1
			Nimbostratus	[b]111.0	7

Pasture Location	Count	n=
CA1**	-	-
CA2	-	-
CA3	[a]4201.0	4
CA4	[ab]798.0	11
CA5	[ab]1598.0	4
CA6	-	-
CA7	[a]1140.0	13
CA8	[b]0	1
CA3,CA6	[b]0	1
CB1	[a]308.0	2
CB1,CB2	[a]1367.0	2
CB2	[b]0	7
CB3	[ab]1237.0	4
CB4	[b]0	1
CB5	[a]2127.0	7

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2b for pasture locations.

Bovitect® Trial

Greatest numbers of black flies were collected around treated and untreated cattle when west winds were blowing but they were not significantly different than numbers collected when NorthEast and South winds were blowing (Tables 4 and 5). Calm conditions and winds from the East and SouthEast also brought high numbers of black flies. Most black flies were collected when skies were clear or when Stratocumulus and Nimbostratus clouds were present but these did not differ significantly from numbers collected when most other cloud types were present.

The treated cattle spent most time in area T1, near to their water source and the backrubber, where greatest numbers of black flies (a mean of 340) were taken (Table 4).

Table 4. Mean numbers of black flies collected around cattle treated with Bovitect® associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[a]0	5	Cirrus	[a]0	1
NorthEast	[ab]326.7	6	Cumulus	[a]93.5	4
East	[bc]309.2	21	Clear	[a]546.0	23
SouthEast	[bc]215.2	12	Stratocumulus	[a]213.0	2
South	[ab]232.0	2	Altostratus	[a]29.7	7
SouthWest	[bc]265.5	4	Altostratus Altocumulus	[a]265.0	19
West	[a]2023.5	2	Cirrocumulus	[a]0	1
NorthWest	[a]0	4	Stratocumulus Nimbostratus	[a]606.5	2
Calm	[bc]320.6	10	Altostratus Stratocumulus	[a]0	2
			Nimbostratus	[a]0	2
			Cumulostratus Cumulus	[a]0	1
			Smoke	[a]0	1

Pasture Location	Count	n=
T1**	[a]341.6	58
T2	-	-
T2,T3	[a]0	1
T3	[a]0	1
T4	[a]0	4
T5	-	-

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2a for pasture locations.

Untreated cattle spent most time on a hill (CA7) but only slightly more than in open pasture (CB5). Greatest numbers of black flies (a mean of 3000) were taken when the cattle were in open pasture (CA3) but was not significantly different from collections made in other areas, on the hills (CA7, CA4) or in the bush (CA1) (Table 5). Thus, topographic features did not influence the numbers of black flies collected for either the treated or untreated groups although treated animals tended to spend almost all of their time near the backrubber.

Table 5. Mean numbers of black flies collected around cattle not treated with Bovitect® associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[d]0	5	Cirrus	[b]0	1
NorthEast	[abc]848.5	6	Cumulus	[ab]177.0	4
East	[cd]173.5	18	Clear	[ab]1319.0	21
SouthEast	[bcd]589.7	12	Stratocumulus	[ab]132.0	2
South	[ab]706.0	1	Altostratus	[ab]110.0	6
SouthWest	[bcd]1276.8	4	Altostratus Altocumulus	[ab]393.0	18
West	[a]5541.0	2	Cirrocumulus	[a]147.0	1
NorthWest	[cd]36.8	4	Stratocumulus Nimbostratus	[ab]899.0	2
Calm	[cd]599.4	10	Altostratus Stratocumulus	[b]0	2
			Nimbostratus	[b]0	3
			Cumulostratus Cumulus	[b]0	1
			Smoke	[b]0	1

Pasture Location	Count	n=
CA1**	[a]1600.0	1
CA2	[bc]449.5	4
CA3	[abc]3083.3	4
CA4	[ab]328.5	5
CA5	[c]0	1
CA6	-	-
CA7	[abc]635.2	20
CA8	-	-
CB1	[c]0	1
CB2	[c]0	4
CB3	[abc]912.2	4
CB3,CB4	[c]0	1
CB4	[c]0	2
CB5	[bc]292.1	16

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2b for pasture locations.

1990 Evaluations

Approximately 1,600 flies were collected during the first trial using Atroban Delice®. The number of black flies collected around treated animals averaged 0 per day and around untreated animals 42 flies per day. Analysis of variance demonstrated that significantly fewer black flies (P<0.001) were collected around treated cattle compared to untreated animals (Table 6).

In the 1990 trial using Liquiduster a total of approximately 2,000 flies were collected. Counts averaged 22 per day around treated animals and 57 per day around the untreated group. Analysis of variance demonstrated that significantly fewer black flies ($P<0.05$) were collected around treated cattle compared to untreated animals (Table 6).

Table 6. Mean numbers of black flies collected each day around cattle during each trial in 1990.

Insecticide	Treated	Untreated
Atroban Delice®	42*	0
Liquiduster	22**	57

* Treated and untreated values are significantly different ($P<0.001$).
** Treated and untreated values are significantly different ($P<0.05$).

As in the 1989 trials the most notable changes in cattle behaviour between treated and untreated cattle occurred with the number of tail swishes and ear twitches counted. Treated animals in both trials had significantly ($P<0.001$) fewer tail swishes and ear twitches when compared to untreated cattle (Fig. 3). In the Atroban Delice® trial significantly ($P<0.05$) more leg kicks were recorded for the untreated group than for the treated group but no significant difference was found in numbers of head swings. There were no observable differences between the two groups in the number of leg kicks or head swings counted during the Liquiduster trial. Cattle not subjected to treatment were also noted to bunch much more frequently and tended to migrate to higher parts of the pasture during bad fly days.

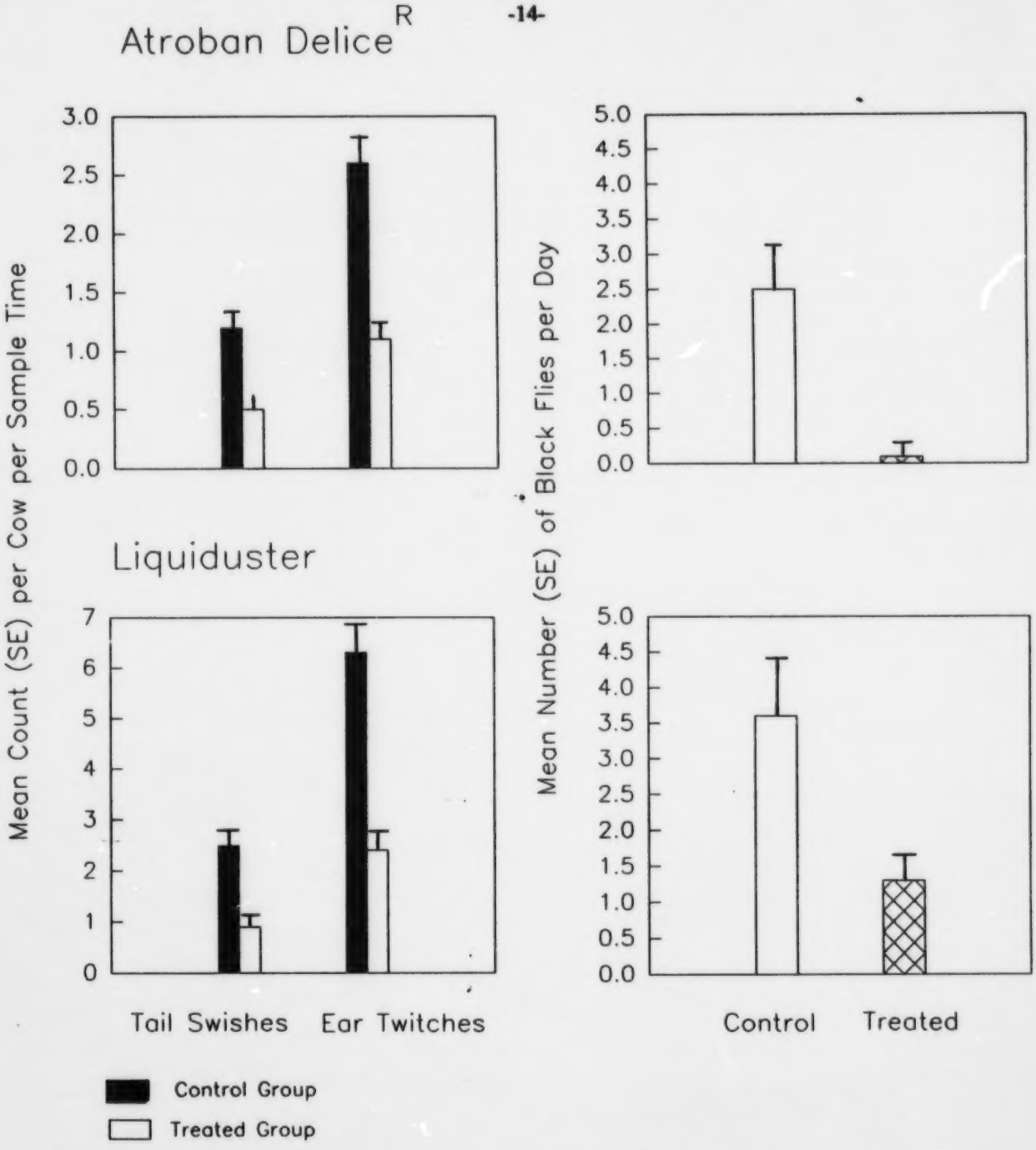

Fig. 5. Comparison between control and treated cattle of counts for tail swishes, ear twitches and black fly numbers for Atroban Delice® and Liquiduster insecticide trials.

Temperature, relative humidity, wind speed, cloud cover, and barometric pressure did not show any strong correlations ($r \leq 0.37$) to numbers of black flies around either group. The effects of wind direction, cloud type, and pasture location varied (Tables 7-10).

Atroban Delice[R] Trial

The greatest numbers of black flies were collected around treated and untreated cattle when winds were from the northeast and were significantly different from numbers collected when winds were blowing from other directions (Tables 7 and 8). Most black flies were collected around treated and untreated cattle when Cirrus clouds were present and differed significantly from numbers collected when other cloud types were present.

During the Atroban Delice[R] trial treat cattle spent most of their time in the bush near the backrubber and their water source (T1 Fig. 2a) (Table 7). Few black flies were collected. This suggests that the cattle may have been staying around the backrubber or water.

Table 7. Mean numbers of black flies collected around cattle treated with Delice[R] associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	a,b0	54	Cirrus	a0.8	42
NorthEast	a1.3	36	Cumulus	b0	90
East	b0	72	Clear	b0	132
SouthEast	b0	114	Stratocumulus	b0.1	198
South	b0	54	Cumulonimbus	b0	12
SouthWest	b0	66	Altostratus Altocumulus	b0	126
West	b0	48	Cirrus Altocumulus	b0	6
NorthWest	b0	150	Cumulostratus Cumulus	b0	18
Calm	b0	60	Stratocumulus Cumulonimbus	b0	6
			Nimbostratus	b0	6
			Smoke	b0	18

Pasture Location	Count	n=
T1**	a0.1	484
T1,T2	a0	6
T2	a0	19
T2,T3	a0	12
T3	a0	30
T4	a0	55
T5	a0	25
T1,T3	a0	11
T3,T5	a0	12

*Means preceded by the same letter are not significantly ($P>0.05$) different using Duncan's Multiple Range Test.
**See Fig. 2a for pasture locations.

Untreated cattle spent slightly more time on the hills in their pasture (Areas CA4, CA5, CA7, CB4 and CB5) (Table 8) but numbers collected around these cattle (CA7) were not significantly different than those collected when the cattle were in open pasture (CA3). Thus, topographic features did not influence the numbers of black flies collected for either the treated or untreated groups although treated animals tended to spend more time in a smaller area (close to the backrubber).

Table 8. Mean numbers of black flies collected around cattle not treated with Delice[R] associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[de]0	54	Cirrus	[b]17.5	42
NorthEast	[a]30.3	36	Cumulus	[cd]1.3	90
East	[de]0.4	72	Clear	[c]2.4	132
SouthEast	[cd]1.0	108	Stratocumulus	[cd]2.1	192
South	[e]0	54	Cumulonimbus	[d]0	12
SouthWest	[e]0	66	Altostratus Altocumulus	[cd]0.7	126
West	[b]2.1	48	Cirrus Altocumulus	[a]4.0	6
NorthWest	[c]2.3	150	Cumulostratus Cumulus	[d]0	12
Calm	[e]0	60	Stratocumulus Cumulonimbus	[d]0	6
			Nimbostratus	[d]0	6
			Smoke	[d]0	18

Pasture Location	Count	n=
CA1**	-	-
CA2	[b]0	6
CA3	[a]2.8	18
CA4	[b]0	60
CA4,CA5	[b]0	12
CA5	[b]0	84
CA5,CA6	[b]0	6
CA6	[b]0	18
CA7	[a]9.7	162
CA8	-	-
CA3,CA6	[b]0	6
CA5,CA8	[b]0	6
CB1	[b]0	18
CB1,CB2	[b]0	6
CB2	[b]0	60
CB3	[b]0.6	72
CB4	[b]0.4	66
CB5	[b]0	48

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2b for pasture locations.

Liquiduster

Greatest numbers of black flies were collected around treated cattle when winds were from the southwest but were not significantly different from numbers collected when winds were blowing from the north northwest or south (Table 9) On the other hand, winds from the southeast brought significantly more black flies to untreated cattle than winds from other directions (Table 10). Significantly more black flies were collected around treated and untreated cattle when Cirrus clouds were present compared to other cloud types.

During the Liquiduster trial treated cattle spent most of their time in the bush near the backrubber and their water source (T1) (Table 9) but significantly more black flies were collected when the cattle were in open pasture (Ts, T4 and T5).

Table 9. Mean numbers of black flies collected around cattle treated with Liquiduster associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[a]3.8	18	Cirrus	[a]1.2	24
NorthEast	[b]0	18	Cumulus	[bc]0.5	42
East	[b]0	42	Clear	[b]1.3	113
EastNorthEast	[b]0	6	Stratocumulus	[c]0	90
East	[b]0	18	Altostratus	[c]0	6
South	[a]1.2	24	Altostratus Altocumulus	[bc]0.8	90
SouthWest	[a]4.4	61	Altocumulus Stratocumulus	[c]0	6
WestSouthWest	[b]0	4	Nimbostratus	[c]0	12
West	[b]0.1	102			
NorthWest	[a]2.4	72			
Calm	[b]0	42			

Pasture Location	Count	n=
T1**	[cd]1.5	227
T1,T2	[d]0	6
T2	[d]0	6
T2,T3	[d]0	12
T3	[cd]0.4	30
T3,T4	[d]0	6
T4	[d]0	42
T5	[c]3.7	30
T3,T4,T5	[a]9.0	6
T1,T5	[b]3.7	6
T2,T4	[d]0	12
T1,T3	[d]0	24

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.
**See Fig. 2a for pasture locations.

Untreated cattle spent slightly more time on the hills in their pasture (CA7 and CA8) than in the stream bed (CB1 and CB2)(Table 10). Significantly more black flies were collected around cattle in open pasture (CA5, CA3 and CA5,CA6) than in the other areas. Although topographic features may have influenced somewhat the numbers of black flies collected from the untreated group the significant difference between numbers collected around treated and untreated group (Table 6) indicates that topography did not have a great effect on the evaluation.

Table 10. Mean numbers of black flies collected around cattle not treated with Liquiduster associated with wind direction, cloud type and pasture location.

Wind Direction	Count	n=	Cloud Type	Count	n=
North	[ab]7.6	18	Cirrus	[a]26.8	24
NorthEast	[c]2.0	18	Cumulus	[bc]1.3	42
EastNorthEast	[d]0	6	Clear	[b]3.6	138
East	[d]0.2	42	Stratocumulus	[cd]0.2	90
SouthEast	[a]33.3	18	Altostratus Altocumulus	[b]2.8	90
South	[b]3.3	24	Altostratus	[d]0	6
SouthWest	[bc]2.2	60	Altocumulus Stratocumulus	[d]0	6
WestSouthWest	[d]0	6	Nimbostratus	[d]0	12
West	[d]1.0	102			
NorthWest	[bc]5.3	72			
Calm	[d]0	42			

Pasture Location	Count	n=
CA1**	[e]0	6
CA2	[e]0	12
CA3	[b]13.8	6
CA4	[e]1.2	30
CA5	[e]0.3	48
CA5,CA6	[b]5.7	6
CA6	[cd]3.8	30
CA6,CA7	[c]4.3	12
CA7	[e]0.7	84
CA8	[de]0.8	72
CA7,CB5	[d]2.0	12
CA6,CA7,CB5	[b]5.0	6
CB1	-	-
CB1,CB2	[e]2.8	60
CB2	[cd]14.8	42
CB3	-	-
CB4	[e]0	42
CB5	[a]19.9	12

*Means preceded by the same letter are not significantly (P>0.05) different using Duncan's Multiple Range Test.

**See Fig. 2b for pasture locations.

Silhouette Trap Results

Results of weekly collection of adult black flies from silhouette traps, when compared with results from other areas of in the Black Fly Zone, indicated that the numbers of black flies occurring at the study site in 1990 were typical of populations throughout the zone. Black flies, especially *Simulium luggeri*, are usually at chronic problem levels at the study site, as evidenced by the 87,000 and 56,000 collected during the 1989 evaluation trials. In 1990 only 2,000 and 1,600 black flies were collected during the backrubber insecticide evaluations. Mean weekly numbers of *S. luggeri* and *Simulium vittatum* were below 100, a number considered to indicate mild or no harassment (Mason and Kusters 1990), except on two occasions (Fig. 6). Thus black fly populations used in the Atroban Delice® and Liquiduster trials were not typical.

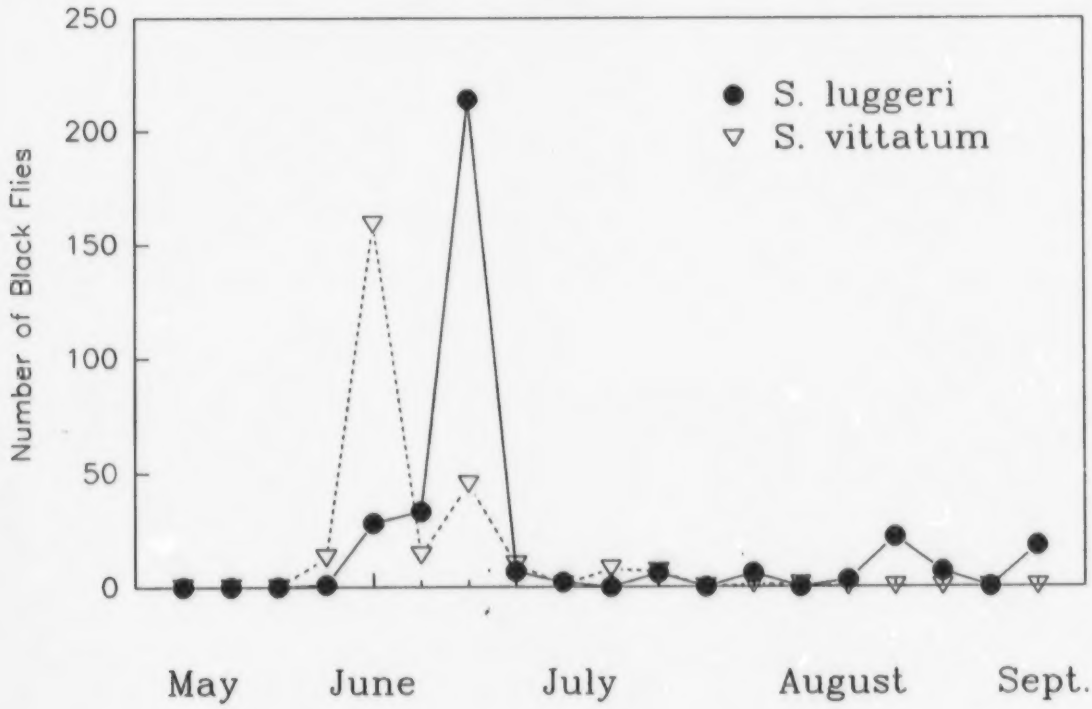

Fig. 6. Number of *Simulium luggeri* and *Simulium vittatum* collected per week at the study site, from May 23 to September 28, 1990.

Conclusions

Results of the study clearly indicate that Ectiban® used in solution with diesel fuel, Atroban Delice® ready to use solution and Liquiduster ready to use solution in a self-contained applicator, when applied by backrubber in a forced use situation, effectively reduced the number of black flies around cattle. In 1989 Ectiban® significantly reduced black fly numbers around cattle by 83%. Bovitect® in a ready to use solution did not significantly reduce the number of flies attacking cattle. Numbers collected around cattle were however reduced by approximately 56%. Although black fly populations in 1990 were not typical of the study site significant reductions between treated and untreated cattle were clearly demonstrated for Atroban Delice® (100%) and Liquiduster (72%).

Measured weather parameters did not bias the results. Topographical features showed some influence in numbers of black flies collected only for the Liquiduster trial. However significantly ($P<0.05$) fewer black flies were collected around treated animals than untreated animals in that trial.

Impact on Saskatchewan Agriculture

The results of this study will provide efficacy data that can be used in a registration submission to Agriculture Canada Pesticides Directorate under the Minor Use Program. If the applications are successful additional insecticides to protect cattle from black fly attack will become available to cattle producers in the northeastern agricultural areas of Saskatchewan. We recommend that the data for Ectiban®, Atroban® and Liquiduster be submitted to Pesticides Directorate, Agriculture Canada, for registration under the Minor Use Program.

Acknowledgments

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c) TECHNOLOGY TRANSFER

Publications

1. Mason, P.G. and P.M. Kusters. 1989. Control of black flies using the backrubber insecticide Bovitect[R]. Pest. Res. Rep. 1989. p. 133.

2. Mason, P.G. and P.M. Kusters. 1989. Control of black flies using the backrubber insecticide Ectiban[R]. Pest. Res. Rep. 1989. p. 135.

3. Mason, P.G. and P.M. Kusters. 1990. Control of black flies using the backrubber insecticide Atroban Delice[R]. Pest. Res. Rep. 1990. p.

4. Mason, P.G. and P.M. Kusters. 1990. Control of black flies using the backrubber insecticide Liquiduster. Pest. Res. Rep. 1990. p.

Seminars and Abstracts

1. Kusters, P.M. and P.G. Mason. 1989. Evaluation of permethrin insecticides used in backrubbers for control of black flies (*Simulium* spp.) attacking cattle. Proceedings of 37th Annual Meeting of the Entomological Society of Saskatchewan. p. 29.

d) PERSONNEL

Person	Percent of Time on Project
P.G. Mason, Project Leader	5.0
P.M. Kusters, Field Supervisor	25.0
P. Burgess, Summer Student	25.0
L. Holmquist, Summer Assistant	100.0

e) EQUIPMENT

No equipment with a value of more than $500 was purchased with the funds.